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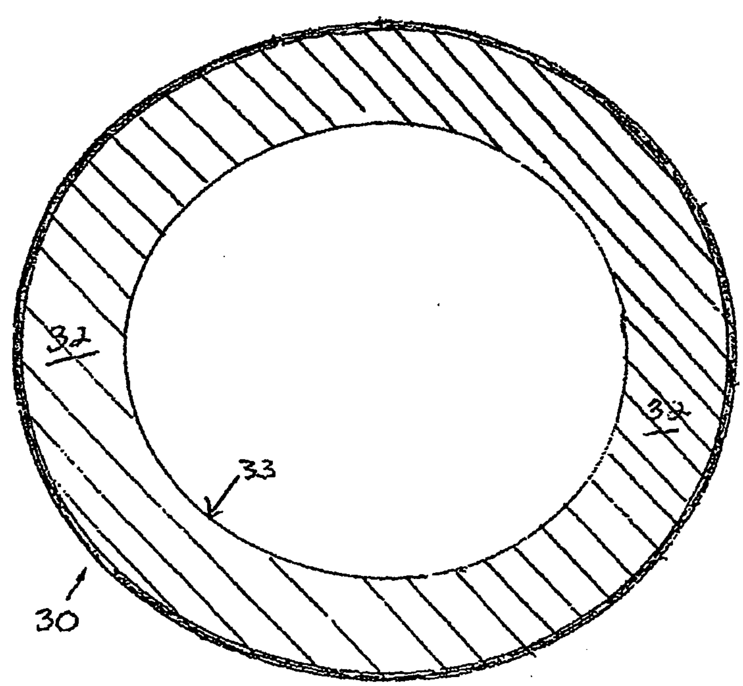
(54) Title: METHOD AND APPARATUS FOR INCREASING THE LIFETIME OF A WORKPIECE RETAINING STRUCTURE AND CONDITIONING A POLISHING SURFACE



(57) Abstract: A method and apparatus for polishing workpieces such as semiconductor wafers which includes a wafer carrier having a retaining structure (30) which functions as an in-situ conditioner for a polishing surface. The retaining structure (30) has either a diamond-like coating or a chemical vapor deposition (CVD) diamond coating applied to at least one surface (32) thereof thereby extending the life of the retaining structure (30). Properties of the diamond-like coating or CVD diamond coating applied to the retaining structure, such as surface roughness, may be tailored for specific applications such as in-situ conditioning.

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METHOD AND APPARATUS FOR INCREASING THE LIFETIME OF A WORKPIECE RETAINING STRUCTURE AND CONDITIONING A POLISHING SURFACE

Field of the Invention

The present invention relates generally to the art of polishing and planarizing workpieces such as semiconductor wafers. More particularly, the present invention relates to a workpiece or wafer carrier having an improved wafer retaining structure which can also function as an in-situ conditioner for a polishing surface.

Background of the Invention

In the semiconductor industry, integrated circuits are formed on a base substrate material known as wafers which are comprised of single crystal silicon. These semiconductor wafers are typically formed by growing an elongated cylinder or ingot of single crystal silicon and then slicing individual wafers from the cylinder. Multiple layers of conductive material and dielectric material are then built up on the wafer to form a multilevel integrated circuit. In order to ensure the functionality and reliability of such integrated circuits, the surface of the wafer on which the integrated circuitry is constructed, as well as the material layers applied to the wafer as the integrated circuitry is built, must be extremely flat and free of irregularities or projections. The removal of projections and other imperfections in order to achieve a flat substrate surface is referred to in the art as planarization.

The increasing demand for integrated circuit devices has resulted in an increase in demand for semiconductor wafers. Further, the need for high density integrated circuits, as well as the need for higher production throughput of integrated circuits on a per-wafer basis, has resulted in a need for increasing the flatness of the semiconductor wafer surface by planarization, both during initial production of the semiconductor wafers as well as during the actual building of the integrated circuits on the wafer surfaces. Accordingly, numerous chemical mechanical polishing (CMP) machines and processes have been developed, and are well known in the art, to provide for the controlled planarization of semiconductor wafers and the material layers deposited thereon during the formation of integrated circuits.

CMP machines generally include one or more wafer carriers which retain and carry wafers to be planarized, and which press the front faces of the wafers, or surfaces of the wafers on which integrated circuitry will be built, against the upper surface of a rotating polishing pad. During a polishing operation, a pressure applying element (e.g., a rigid plate, a bladder assembly, or the like), which may be integral to the wafer carrier, applies pressure such that the wafer engages the polishing surface with a desired amount of force. The carrier and the

polishing pad are rotated, typically at different rotational velocities, to cause relative lateral motion between the polishing pad and the wafer and to promote uniform polishing. In addition, an abrasive slurry, such as a fumed silica slurry, is usually introduced at the pad-wafer interface in order to augment the planarization process.

Presently known wafer carriers comprise a number of different embodiments. Most conventional carrier assemblies include some form of retaining structure that maintains the position of the wafer under the pressure element during polishing. Most of these prior art wafer carriers minimally include a rotatable housing, a pressure "plate", which can be rigid or flexible, mounted within the housing, and an extension ring or retaining ring. In use, a wafer is held against the pressure plate by any convenient mechanism, such as, by vacuum or by wet surface tension. The pressure plate equally distributes downward pressure against the backside of the wafer as it is pressed against the polishing pad. In addition, the retaining ring is connected around the periphery of the pressure plate thereby functioning to prevent the wafer from slipping laterally from beneath pressure plate as the wafer is polished. Further, the retaining ring is typically made of a strong polymer having high chemical resistance in order to withstand wear and corrosion during polishing with an abrasive slurry. Accordingly, there is a need for a carrier retaining ring which exhibits an increased lifespan, is resistant to wear and corrosion, is inexpensive to make, and results in increased cost effectiveness by reducing the number of times a polishing machine must be shut down in order to replace a carrier ring.

During the polishing or planarization process using wafer carriers, the workpiece (*e.g.* wafer) is typically pressed against the polishing pad surface while the pad rotates about its vertical axis. In addition, to improve the polishing effectiveness, the wafer may also be rotated about its vertical axis and oscillated back and forth over the surface of the polishing pad. It is well known that polishing pads tend to wear unevenly during the polishing operation, causing surface irregularities to develop on the pad. To ensure consistent and accurate planarization and polishing of all workpieces, these irregularities should either be removed or accounted for.

One method of removing the surface irregularities which develop in the polishing pad is to condition or dress the pad with some sort of roughing or cutting means. Generally this truing or dressing of the polishing pad can occur either while the wafers are being polished (in-situ conditioning), or between polishing steps (ex-situ conditioning). An example of ex-situ conditioning is disclosed in *Cesna, et al.*, U.S. Patent No. 5,486,131 , issued on January 23, 1996, and entitled Device for Conditioning Polishing Pads. An example of in-situ conditioning is disclosed in *Karlsrud*, U.S. Patent No. 5,569,062, issued on October 29, 1996, and entitled Polishing Pad Conditioning. Both the *Cesna, et al.* patent and the *Karlsrud* patent are herein

incorporated by reference.

Generally, in the semiconductor wafer polishing and planarization context small roughing or cutting elements, such as diamond particles, are used to condition the polishing pads. As shown in both the *Cesna, et al*, patent and the *Karlsrud* application, both in-situ and ex-situ conditioning apparatus utilize circular ring conditioners which have these cutting elements secured to a bottom flange of the ring. Generally, these cutting elements are secured to the bottom surface of the flange of the carrier ring by an electroplating process or brazing process. Electroplating produces a simple mechanical entrapment of the cutting elements on the carrier ring by depositing metal, for example in a layer-by-layer fashion around the cutting elements until they are entrapped. However, one problem with the electroplating process is that the electroplating bond holding the cutting elements to the ring surface is relatively weak and the cutting elements occasionally become dislodged from the conditioning ring and embedded in the polishing pad. Further, because the electroplating bond is susceptible to shearing forces, a substantial amount of bonding material is needed to hold the cutting elements in place. As a result, the bonding material actually covers most, if not all, of the many cutting elements, thereby compromising the conditioning capacity of the conditioning ring. Thus, the previously mentioned brazing process is preferred. A detailed discussion of the brazing process is discussed herein as well as in *Holzapfel, et al.*, U.S. Patent No. 5,842,912, issued December 1, 1998, which is herein incorporated by reference.

The cutting elements which are secured to the bottom surface of the flange of carrier rings may comprise diamonds, polycrystalline chips/slivers, silicon carbide particles, and the like. However, regardless of whether the conditioning rings are braze plated or electro-plated in order to retain the cutting elements, such as diamonds, these processes are not ideal in that they exhibit a very short lifetime which results in diamond loss, diamond fracture, or plating wear. These lost or fractured diamonds can cause severe scratches in the wafers that are being polished. Wafers that are scratched are considered to be scrap and this can result in increased costs to the consumer. Further, the short lifetime of the conditioning rings due to plating wear is significant in that the conditioning rings are typically the most expensive consumable component part on the CMP apparatus.

Although the brazing of the cutting elements to secure them to the carrier ring is preferable over the electroplating process, there are still some problems associated with the brazing process. These problems include the substantial mechanical and/or chemical manipulations required, including high pressure and high temperature applications, for processing as well as the resulting unreliability of the bonds that are created from such

processing.

Accordingly, there is a need for an improved method and apparatus for conditioning polishing pads used in the polishing or planarization of semiconductor wafers. More particularly, with reference to the above need for an inexpensive carrier retaining structure which exhibits an increased lifespan and resistance to wear and corrosion, there is a need for a simple and efficient method and apparatus for providing such a retaining structure which can also function in conditioning a polishing pad.

Summary of the Invention

It is a principal object of the present invention to provide a method and apparatus for polishing a workpiece and conditioning a polishing pad.

It is another object of the present invention to provide a workpiece or wafer carrier having a retaining structure with increased resistance to wear and corrosion which also functions as an in-situ conditioner for a polishing surface.

It is yet another object of the present invention to provide a wafer retaining structure such as, for example, an extension or retaining ring for use within a wafer carrier which is durable, resistant to chemicals, and exhibits an increased lifespan.

It is still a further object of the present invention to provide a workpiece retaining structure which possesses properties such as, for example, surface roughness, that can be specifically tailored depending upon its application. For example, a retaining ring having a relatively high surface roughness provides an effective in-situ conditioner for a polishing pad.

Yet another object of the present invention is to provide a workpiece retaining structure for use within a wafer carrier which functions as an in-situ conditioning ring that can be processed at lower temperatures and at lower costs.

A still further object of the present invention is to provide an inexpensive retaining workpiece structure such as, for example, a ring for use with a wafer carrier which also functions as an in-situ pad conditioner that increases cost effectiveness in polishing and planarizing wafers due to the decrease in polishing machine downtime required for replacing retaining rings.

The workpiece carrier retaining structure of the present invention preferably includes at least one of a diamond-like carbon coating or chemical vapor deposition (CVD) diamond coating applied to at least one surface of the retaining structure. The retaining structure acts to retain a workpiece, such as a wafer, in a workpiece carrier and also functions as an in-situ conditioner for a polishing pad during wafer polishing.

Diamond-like coatings are based on the same carbon chemistry used to produce thin diamond films but are instead processed at low temperatures. In that diamond-like coatings can be processed at low temperatures, the retaining structure may be made of a variety of inexpensive substrate materials such as epoxy-glass, polycarbonate, acrylic, polyethylene, and glass-ceramic. The retaining structure resulting from coating the retaining structure with a diamond-like coating provides a retaining structure that has increased wear resistance, increased corrosion resistance, a low coefficient of friction, and an increased lifespan.

CVD diamond coatings may also be used to coat retaining structures used in association with wafer carriers to arrive at the wafer carrier retaining structure of the present invention. However, use of CVD to produce diamond film on a retaining structure requires relatively high temperatures and is more costly due to the amount of time, energy and raw materials required to produce reasonable amounts of film.

Methods for making the improved retaining structure of the present invention include the use of ion assisted beam deposition and plasma ion-source implantation to coat the retaining structure with an amorphous carbon film. In addition, the use of a pulsed laser on a graphite target that is evaporated by laser radiation may be used to create a diamond-like coating. Further, with respect to using actual diamond coatings to cover the retaining structure, chemical vapor deposition of diamond material is used to create a diamond film.

The objectives, features, and advantages of the present invention will become more apparent to those skilled in the art from the following more detailed description of the exemplary embodiments of the invention made in conjunction with the accompanying drawings.

Brief Description of the Drawings

Figure 1 is a side cross-sectional view of one exemplary embodiment of a prior art semiconductor wafer carrier element.

Figure 2 is a carrier extension/retaining ring comprising a diamond-like coating in accordance with the present invention.

Figure 3 is a flow chart showing an exemplary embodiment of the method of the present invention for increasing the lifetime of a workpiece carrier retaining structure and conditioning a polishing surface.

Figure 4 is a flow chart showing another exemplary embodiment of the method of the present invention for increasing the lifetime of a workpiece carrier retaining structure and conditioning a polishing surface.

Detailed Description of the Preferred Embodiments

The present invention relates to a workpiece or wafer carrier having an improved wafer retaining structure which may also function as an in-situ conditioner for a polishing surface.

Figure 1 shows one embodiment of a prior art wafer carrier element which may be used in accordance with the improved retaining structure of the present invention. Carrier element 10 comprises a pressure plate 12, a protective layer 14, a retaining structure in the form of a retaining ring 16, and a rotation drive shaft 18. The terms retaining ring and extension ring are used synonymously throughout this document. Pressure plate 12 applies an equally distributed downward pressure against the backside of a wafer 20 as it is pressed against polishing pad 22. Protective layer 14 resides between pressure plate 12 and wafer 20 to protect the wafer 20 during the polishing process. Protective layer 14 may be any type of semi-rigid material that will not damage the wafer as pressure is applied; for example, a urethane type material. Wafer 20 may be held against protective layer 14 by any convenient mechanism, such as, for example, by vacuum or by wet surface tension. Circular retaining ring 16 preferably is connected around the periphery of protective layer 14 and prevents wafer 20 from slipping laterally from beneath the protective layer 14 as the wafer is polished. Retaining ring 16 is generally connected to pressure plate 12 by bolts 24.

Polishing pad conditioning devices currently known in the art, including carrier retaining rings, typically employ diamond particles as the roughing elements or cutting elements used to condition polishing pads. Conditioning devices for conditioning polishing pads by contacting the conditioning devices with the pads are configured with cutting elements, such as diamonds, electroplated to the bottom surfaces of the conditioning devices, or thin film diamond deposition applied over the bottom surfaces of the conditioning devices.

Diamond like coatings (DLC's) have recently gained attention in diamond technology for a variety of applications which require wear resistance and decreased friction including, for example, optical windows, cutting tools and biomedical applications. DLC's are based on the same carbon chemistry that is used to produce thin diamond films but are lower in cost and can be processed at much lower temperatures.

The method and apparatus of the present invention include applying a DLC to at least one surface of a carrier retaining structure, such as a retaining ring, in order to provide a carrier retaining structure that is wear and corrosion resistant, has a longer lifespan and also provides for the simultaneous conditioning of a polishing pad when the retaining structure is used within a wafer carrier to polish a wafer. The DLC may be applied to the wafer extension or retaining ring in a number of ways. For example, the DLC may be applied to the retaining ring by ion

assisted beam deposition or plasma ion-source implantation. Further, Sandi National Laboratories located in Albuquerque New Mexico has developed a simple, inexpensive process for producing a DLC which uses a pulsed laser on a graphite target to deposit an amorphous carbon film, having a high percentage of diamond-like bonds with high initial stress, at room temperature. The amorphous carbon film is then heated to relieve the internal stress. The result is a stress free diamond like coating which shows negligible degradation. Diamond-like coatings have been used for applications such as metal tools, automotive components and plastics. Other contemplated applications for DLC's include chemical-resistant vessels, optical applications, low friction bearings and medical implants including catheters, surgical seals, and stents. However, the application of DLC's to the semiconductor industry and, in particular to wafer carrier components such as retaining rings, has not previously been considered. Current practice for wafer retaining rings involves soft materials that do not damage the wafers or leave hard particles in the pad. DLC's can be deposited on the wear area of a retaining ring to condition the pad increase the lifetime of the consumable without coming in contact with the wafer. For example, the inner diameter of the retaining ring can still be made of soft plastic that contacts the wafer. The wear area of the ring is coated with DLC to increase its lifetime. In addition, the DLC coating follows the roughness of the substrate surface. Therefore, if the ring material is lapped to a desired surface roughness, the coating will imitate this surface roughness for in-situ pad conditioning.

Examples of diamond like coatings for use with the method and apparatus of the present invention include Diamonex DLC protective coatings by Diamonex located in Allentown, PA and TETRABOND produced by Multi-Arc, Inc. located in Duncan, SC. TETRABOND is an amorphous diamond coating which purports to bridge the gap between chemical vapor deposition diamond films and Diamond Like Carbon films. Specifically, the producers of TETRABOND claim that it is more stable at elevated temperatures in humid conditions than DLC's which contain a greater amount of hydrogen. In addition, TETRABOND is harder than DLC's. However, TETRABOND requires a conductive surface for deposition and its application is therefore limited to conductive surfaces only, such as metals.

Table 1 compares the properties of natural diamond, chemical vapor deposition diamond, and diamond-like carbon.

TABLE 1

Properties of CVD and DLC Films Compared to Natural Diamond

PROPERTIES	NATURAL DIAMOND	CHEMICAL VAPOR DEP. DIAMOND	DIAMOND-LIKE CARBON
Microhardness (kg/mm^2) (1 kg/mm^2 = 9.806 MPa)	98.07 GPa 10,000	78.4 - 98.07 GPa 8,000 - 10,000	9.81GPa - 39.2 GPa 1,000 - 4,000
Chemical Resistance	Inert	Inert	Inert
Roughness	N/A	3.0 - 0.1 microns	<.001 microns
Friction Coefficient	0.1	0.1 (post-polishing)	0.1
Deposition Temp °C	N/A	800 - 1,000°C	80 - 150°C
Density (g/cm^3)	3.5	3.2 - 3.4	1.7 - 2.2
Thermal Conductivity (W/m °K)	2,000	1,000 - 1,300	1 - 5

Like natural diamond and chemical vapor deposition diamond, diamond-like carbon exhibits low friction and chemical inertness. However, although diamond like carbon is not as hard as chemical vapor deposition diamond, it results in an exceptionally smooth coating and can be processed at much lower temperatures than chemical vapor deposition diamond, thereby reducing costs and providing increased resistance to wear and corrosion. Due to the low processing temperature for diamond-like carbon, a wide variety of materials can be coated with diamond-like carbon, including plastics.

Accordingly, one preferred embodiment of the present invention comprises the application of a diamond-like carbon coating covering at least one surface of a carrier retaining structure such as the carrier retaining ring shown in Figure 2. The carrier ring shown in Figure 2 comprises a ring member 30 having at least a bottom surface 32 of the ring member 30, i.e. that surface of the retaining ring which comes into contact with a polishing surface during polishing, covered with a diamond-like coating as described above. In addition, if necessary, the inner diameter 33 of the ring member 30 may be covered with a soft inner coating to avoid scratching or damaging the workpiece where the ring member 30 comes into contact with the workpiece.

Although the application of a diamond-like carbon coating to a carrier retaining structure comprises a preferred method and apparatus of the present invention due to costs, the present invention also contemplates the use of chemical vapor deposition (CVD) diamond coating to arrive at the method and apparatus of the present invention for increasing the lifetime of a workpiece retaining structure and conditioning a polishing surface. In contrast to diamond-like carbon coating, CVD coatings are true diamond coatings deposited at much higher temperatures than diamond-like coatings. Although higher temperature resistant and consequently more expensive materials are required for this process, the concept of the

application of this type of hard wear resistant and corrosion resistant film for retaining rings in chemical mechanical planarization is novel.

CVD coatings have the added advantage of superior hardness to diamond-like coatings as (see Table 1). In addition, CVD processing can actually deposit varying surface roughness films on the substrate depending on the processing conditions. Hence, a rough CVD film can be deposited on a smooth substrate to act as an in-situ pad conditioner.

Figure 3 depicts a flow chart showing one exemplary method of the present invention for increasing the lifetime of a workpiece carrier retaining structure and conditioning a polishing surface. Only the most basic steps of the method are shown. It will be appreciated by those skilled in the art that additional processing steps and application steps may be performed without changing the overall characteristics, benefits and advantages of the present invention.

First, in step one 40, a retaining structure is formed from an inexpensive substrate material. As previously described in the exemplary embodiment of the present invention where a diamond-like coating is applied to the retaining structure, the inexpensive substrate material may include epoxy-glass, polycarbonate, acrylic, polyethylene, glass-ceramic, and any other inexpensive substrate that exhibits the requisite hardness desired for a carrier retaining structure. Next, in step two 42, a surface of the inexpensive substrate is roughened to achieve a desired amount of conditioning. After conditioning a surface of the inexpensive substrate, a diamond-like coating is applied to at least one surface of the retaining structure at low temperature in step three 44. The diamond-like coating may be applied by combining the carbon chemistry utilized with diamond thin films and ion assisted beam deposition, plasma ion-source implantation, or laser radiation of a graphite target. The application of the diamond-like coating at low temperature ensures that the inexpensive substrate comprising the retaining structure withstands the application process and results in a functional retaining structure having appropriate strength. Steps one, two and three 40,42,44 result in a carrier retaining structure in accordance with the present invention which undergoes less wear and corrosion than prior art retaining structures and also enjoys an increased lifespan with respect to prior art retaining structures such as prior art retaining rings.

Next, the retaining structure is positioned within a typical workpiece carrier element in step four 46. After a workpiece is positioned within the carrier element, the workpiece and retaining structure of the present invention are pressed against a polishing surface during polishing of the workpiece in step five 48. As a result, the retaining structure of the present invention also functions as an in-situ conditioner for a polishing surface such as a polishing pad used in wafer polishing.

The same concept for coating inexpensive materials can also be applied to hard materials such as steel or ceramic. For example, silicon carbide (SiC) ceramic extension ring material densified through a liquid phase sintering can be coated with a soft coating such as Teflon on the wafer contact surface and a DLC for the wear surface. Although SiC is extremely hard, grain pull-out can still be a concern. Liquid phase sintering of SiC is accomplished by mixing softer ceramic materials such as alumina-yttria and forming a liquid at high temperature (>1700°C) to fully densify the SiC into a two-phase system of SiC grains and a second alumina-yttria second phase. Microstructural analysis of this material will show that entire SiC grains can be surrounded by this liquid. Over time, polishing can wear away the second phase leaving a loose SiC grain which can break loose from the ring to possibly scratch a wafer. By coating the wear surface with DLC, the grain pull-out concern is greatly minimized. In addition, the full hardness of DLC will be realized by utilizing a hard substrate base material.

Turning now to Figure 4, another flow chart is shown depicting another exemplary method of the present invention for increasing the lifetime of a wafer carrier retaining structure and conditioning a polishing surface. Once again, only the most basic steps are shown and it will be appreciated by those skilled in the art that additional processing steps and applications steps may be performed without changing the overall benefits and characteristics of the present invention.

In step one 50, a workpiece retaining structure is formed from a high-temperature substrate material such as SiC. Next, in step two 52, chemical vapor deposition of a diamond material is performed at a relatively high temperature, e.g. 800 - 1000 degrees C, to coat a surface of the workpiece retaining structure. This results in a workpiece retaining structure that has an increased resistance to wear and corrosion over prior art retaining structures. The workpiece retaining structure is then positioned within a workpiece carrier apparatus or element in step three 54. Finally, the workpiece and workpiece retaining structure of the present invention are pressed against a polishing surface during polishing of the workpiece in step four 56. Accordingly, the resulting retaining structure also functions as an in-situ conditioner for a polishing surface such as a polishing pad that is used to polish a workpiece such as a wafer.

Those modifications and equivalents which fall within the spirit of the invention are to be considered a part thereof.

I Claim:

1. A workpiece carrier comprising:

a housing releasably coupled to a rotatable shaft;

a pressure element operatively associated with said carrier housing and configured to hold a workpiece against a polishing surface; and

a workpiece retaining structure wherein said workpiece retaining structure includes at least one of a diamond-like coating and a chemical vapor deposition (CVD) diamond coating which covers at least one surface of said retaining structure.

2. The workpiece carrier of claim 1 wherein said retaining structure is comprised of at least one of a polymer, a ceramic, and a metal.

3. The workpiece carrier of claim 1 wherein said retaining structure comprises a ring member.

4. An apparatus for in-situ conditioning of a polishing surface comprising a wafer retaining structure having at least one of a diamond-like coating and a CVD diamond coating covering at least one surface of said wafer retaining structure, wherein said wafer retaining structure is operatively associated with a workpiece carrier such that at least one of said diamond-like coating and said CVD diamond coating on said wafer retaining structure comes into contact with said polishing surface when said workpiece carrier is employed against said polishing surface to polish a workpiece.

5. The apparatus of claim 4 wherein said retaining structure is comprised of at least one of a polymer, a ceramic, and a metal.

6. The apparatus of claim 4 wherein at least one of said diamond-like coating and said CVD diamond coating on said wafer retaining structure form grooves in said polishing surface when said workpiece carrier is employed against said polishing surface during polishing.

7. The apparatus of claim 4 wherein said retaining structure comprises a ring member.

8. A retaining structure for use in retaining a workpiece in a workpiece carrier during polishing wherein said retaining structure includes at least one of a diamond-like coating and a CVD diamond coating applied to at least one surface of said retaining structure.

9. The retaining structure of claim 8 wherein said retaining structure is comprised of at least one of a polymer, a ceramic, and a metal.

10. A retaining ring for in-situ conditioning of a polishing surface during polishing

of a workpiece wherein said retaining ring comprises a ring member having at least one of a diamond-like coating and a CVD diamond coating applied to at least one surface of said ring member.

11. The retaining ring of claim 10 wherein said ring member is comprised of at least one of a polymer, a ceramic, and a metal.

12. The retaining ring of claim 10 wherein said at least one surface of said retaining ring having at least one of a diamond-like coating and a CVD diamond coating comprises a high surface roughness.

13. A method for making a carrier retaining structure having an increased lifespan comprising the steps of:

forming a retaining structure from at least one of a polymer, a ceramic, and a metal; and

applying a diamond-like coating to at least one surface of said retaining structure.

14. The method of claim 13 wherein said step of applying a diamond-like coating to at least one surface of said retaining structure comprises at least one of ion assisted beam deposition, plasma ion-source implantation, and laser deposition of a graphite target.

15. A method for making a carrier retaining structure having an increased lifespan comprising the steps of:

forming a retaining structure from at least one of a polymer, a ceramic, and a metal; and

applying a CVD diamond coating to at least one surface of said retaining structure.

16. The method of claim 15 wherein said step of forming a retaining structure comprises the step of forming a ring

17. A method for retaining a workpiece in a workpiece carrier and simultaneously performing in-situ conditioning of a polishing surface during polishing with said workpiece carrier comprising the steps of:

forming a retaining structure from at least one of a polymer, a ceramic, and a metal; and

applying at least one of a diamond-like coating and a CVD diamond coating to at least one surface of said retaining structure;

operatively associating said retaining structure with a workpiece carrier;

positioning a workpiece within said workpiece carrier;

rotating at least one of a polishing surface and said workpiece carrier; and

pressing said workpiece carrier against said polishing surface such that said workpiece and said surface of said retaining structure having at least one of a diamond-like coating and a CVD diamond coating contact said polishing surface.

18. The method of claim 17 wherein said step of applying a diamond-like coating to at least one surface of said retaining structure comprises at least one of ion assisted beam deposition, plasma ion-source implantation, and laser deposition of a graphite target.

19. The method of claim 17 wherein said step of forming a retaining structure comprises the step of forming a ring member which comprises the retaining structure.

20. The method of claim 17 wherein said step of forming a retaining structure comprises the step of forming a retaining structure from at least one of a polymer, a ceramic, and a metal.

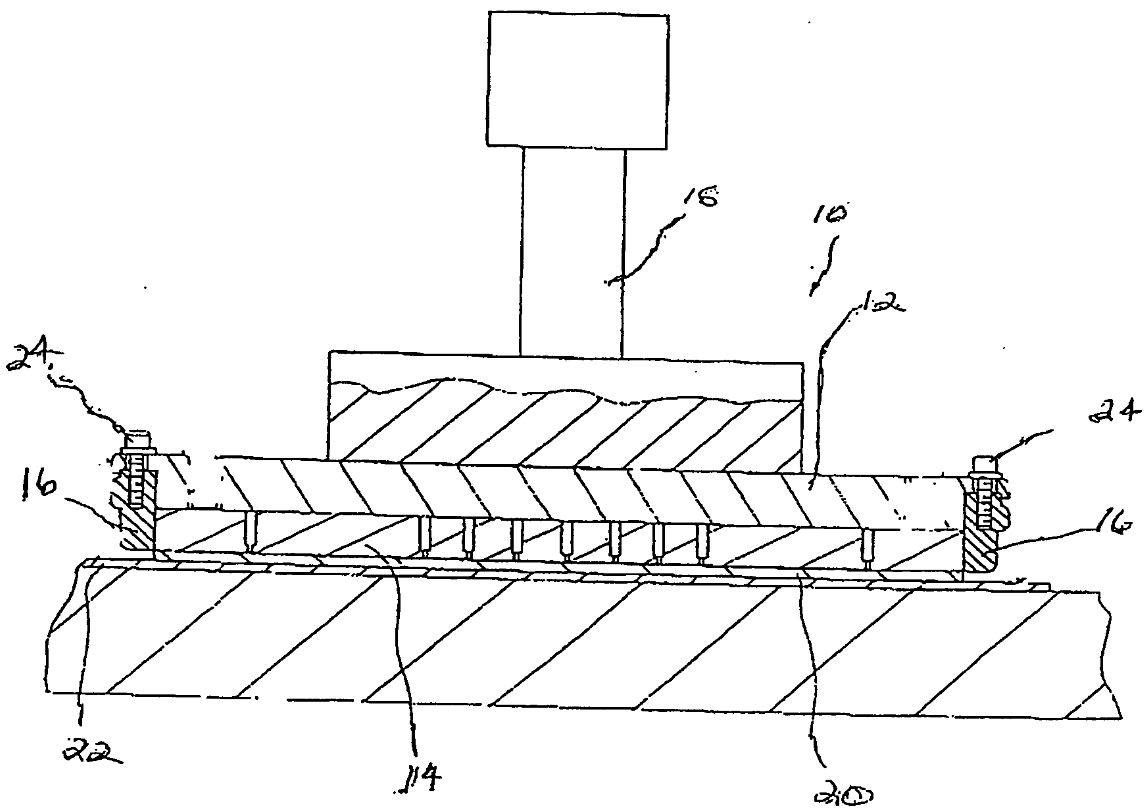

FIG. 1

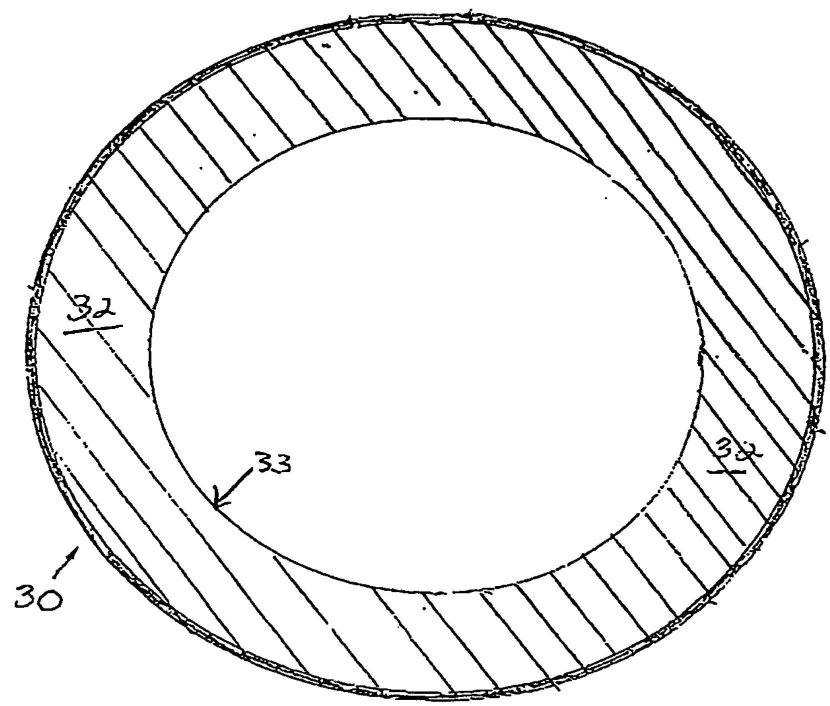

FIG. 2

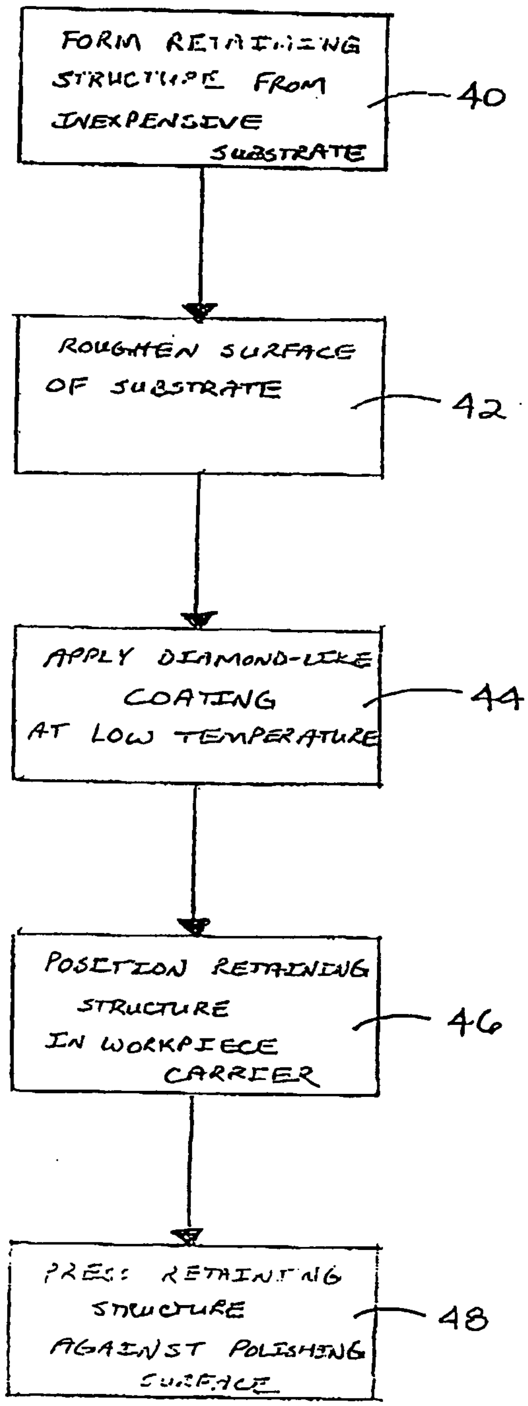
FORM RETAINING STRUCTURE FROM INEXPENSIVE SUBSTRATE
40
ROUGHEN SURFACE OF SUBSTRATE
42
APPLY DIAMOND-LIKE COATING AT LOW TEMPERATURE
44
POSITION RETAINING STRUCTURE IN WORKPIECE CARRIER
46
PRESS RETAINING STRUCTURE AGAINST POLISHING SURFACE
48

FIG. 3

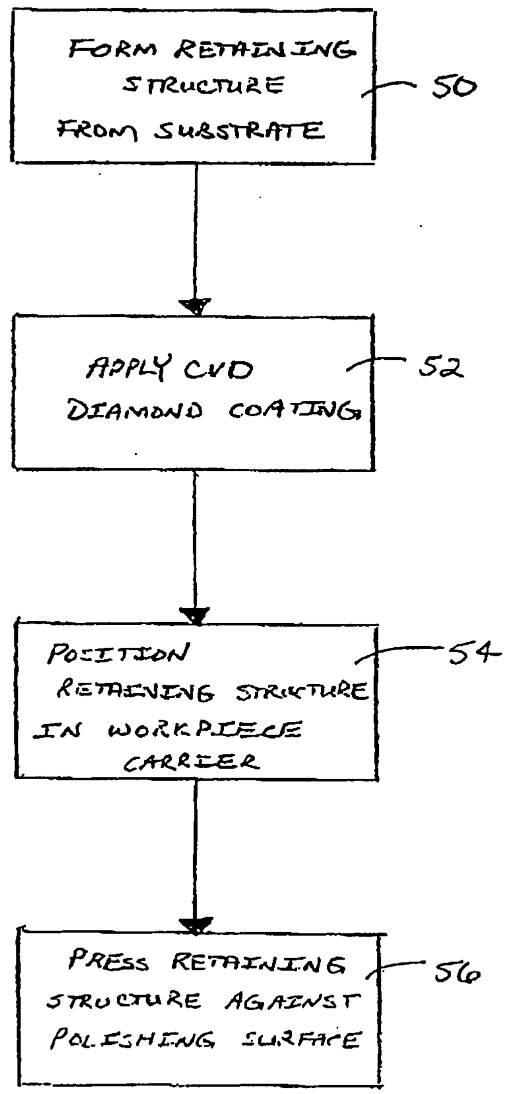
FORM RETAINING STRUCTURE FROM SUBSTRATE
50
APPLY CVD DIAMOND COATING
52
POSITION RETAINING STRUCTURE IN WORKPIECE CARRIER
54
PRESS RETAINING STRUCTURE AGAINST POLISHING SURFACE
56

FIG. 4

INTERNATIONAL SEARCH REPORT

Interr nal Application No
PCT/US 00/16279

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B24B37/04 B24B53/007 C23C16/00 B24D18/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B24B C23C B24D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0 786 310 A (ONTRAK SYSTEMS INC) 30 July 1997 (1997-07-30) column 1, line 21 - line 58 column 3, line 14 - line 17; figure 1 ---	1-5,7-20
Y	US 5 536 202 A (APPEL ANDREW T ET AL) 16 July 1996 (1996-07-16) column 4, line 21 -column 5, line 25 ---	1-5,7-20
A	EP 0 878 269 A (INTEGRATED PROCESS EQUIPMENT C) 18 November 1998 (1998-11-18) abstract; figure 2 ---	6
A	US 4 270 314 A (CESNA JOSEPH V) 2 June 1981 (1981-06-02) column 3, line 25 - line 28; figure 2 ---	1,4,8, 10,13, 15,17
	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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27 September 2000	06/10/2000

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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